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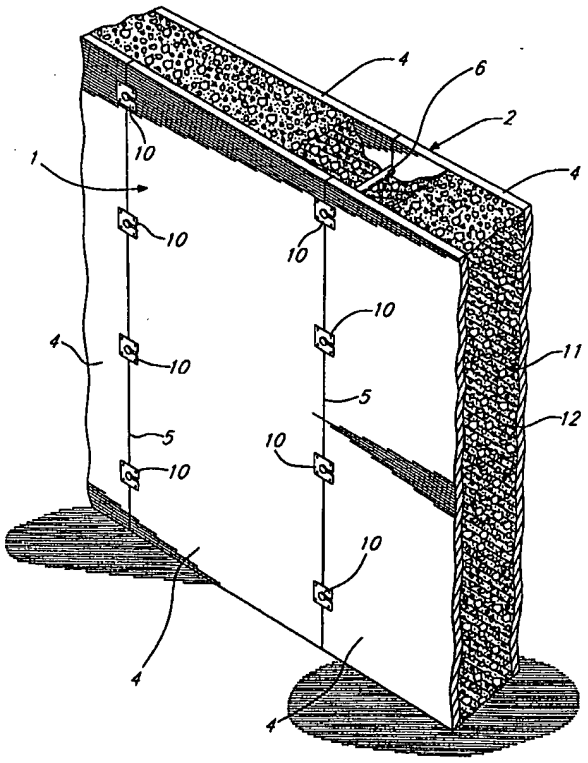
(54) Title: A BUILDING COMPRISING AN ABOVE GROUND WALL COMPONENT COMPRISING A MONOLITHIC INSULATING CONCRETE COMPONENT

(57) Abstract

In a building comprising an above ground wall component comprising a monolithic concrete component, the above ground wall component having a degree of strength to function as a load-bearing building wall, the improvement wherein the monolithic concrete component comprises an insulating concrete (11).



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TITLE: A building comprising an above ground wall component comprising a monolithic insulating concrete component

The present invention relates to an insulating wall structure which comprises a monolithic concrete component.

The construction of a conventional lumber-framed house or building is a relatively slow and expensive process because of the time needed to assemble a large variety of components. A typical load bearing wall may include a wooden frame, together with an inner wall surface of drywall board and an outer wall surface of exterior wall siding.

On the other hand, it has been proposed to reduce construction costs by providing a composite wall fabricated of a combination of forms which provide a space into which concrete can be poured so as to obtain a monolithic concrete wall structure. Thereafter wall boards, such as drywall or plywood, wood chip board, exterior wall siding, etc., may be secured to the finished composite wall structure to provide a finished interior or exterior wall. It is known for example to provide a non-removable insulating type concrete wall forming structure held apart by attachment means such as plastic ties and between which concrete may be poured so as to provide an insulated composite wall structure; in this case however the insulating character of the wall component is attributable (in essence) to the presence of the

insulating wall forming structure.

However, it would be advantageous to have an insulating concrete wall the thermal resistance of which may be adjusted or customized based on the concrete itself, i.e. to have an insitu insulated concrete wall structure.

STATEMENT OF INVENTION

The present invention provides in a building comprising an above ground wall component comprising a monolithic concrete component, said above ground wall component having a degree of strength to function as a load-bearing building wall (i.e. of a strength for supporting a roof, an upper floor or other structure thereon), the improvement wherein the monolithic concrete component comprises an insulating concrete; as desired or necessary a face or facade component may be disposed over at least one of the opposed broad faces thereof, namely either on the exterior side thereof or on the interior side thereof.

The present invention in particular provides in a building comprising an above ground composite wall component, said above ground composite wall component comprising a pair of face (or facade) components and an intermediate monolithic concrete core component therebetween, said above ground (i.e. structural) wall component having a degree of strength to function as a load-bearing building wall, the improvement wherein the concrete core component comprises (e.g. consists of)

an insulating concrete.

In accordance with the present invention the wall component may comprise a pair of panel components arranged in parallel relationship and secured together by connecting members (e.g. thermal insulating connecting members such as for example plastic anchors) such that the space between the plates may be filled with the insulating concrete. In this case the panel components may contribute to the structural strength of the composite wall.

The structure and composition of the elements of a wall component are in any event selected not only on the basis of the desired or necessary load bearing characteristics but also for the desired thermal resistance i.e. the desired R-factor. The term "R-factor" serves to describe the overall thermal resistance of the wall without regard to the thickness thereof. However, the R-factor may be used to described thermal resistance per inch of thickness of the wall component.

In accordance with the present invention it is to be understood that the expression "insulating concrete" comprises any (known) hydraulically or air set cementitious composition (e.g.. a hydraulically hardened composition) which has a relatively low thermal conductivity and in particular, for example, a hardened composition comprising a thermal insulating aggregate as a component thereof.

The hardened cementitious composition may for example be obtained by exploiting any cementitious material or substance which when mixed with water (or some other liquid or both) may form a cementing paste which will set into a rigid shape. The cementitious material or substance may for example comprise materials as described in U.S. patent no. 5,631,097 (the entire contents of which are incorporated herein by reference) such as for example a portland cement, a magnesia cement, an alumina cement etc.. The cementitious composition may also comprise admixture materials or adjuvants such as (short) fibers or (known) chemical admixtures or additives.

Insulating type concretes are known; see for example U.S. patent 5,631,097 mentioned above as well as U.S. patent number 4,541,870, Canadian patent no. 1,225,105 and Canadian patent no. 1,283,666; the entire contents of these patents is herein incorporated by reference. It is known for example to incorporate into a cementitious matrix a thermal insulating aggregate which will provide or impart a concrete with a relatively low thermal conductivity such as for example expanded vermiculite, expanded perlite, expanded polystyrene beads or other types of expanded synthetic polymeric materials and the like. It is also known to incorporate into the cementitious matrix air pockets in addition to or in place of the above mentioned thermal insulating aggregates in order to impart the concrete with a desired degree of insulation characteristics.

As mentioned above, a cementitious matrix may have fibers incorporated therein.

These may be incorporated into a cementitious matrix in order to increase the strength thereof, i.e. in order to increase, for example, the tensile and/or compressive strength thereof. The fibers may for example be made of synthetic materials including polyolefins, such as polyethylene and polypropylene; polyesters; polyvinyl chloride; polyvinylidene chloride; polyamides and aromatic polyamides; etc..

The term fibers as employed herein shall be understood to include monofilament materials, multifilament materials, slit films etc.. The fibers may have any configuration e.g. cross-sectional configurations such as rectangular, square, round, oval, hollow, triangular, and the like. Additionally, the fibers may be tri-lobal, multi-lobal, fibrillated, collated, bonded fibrils, entangled monofilaments or monofilaments and the like; please see figure 3 of U.S patent no. 5,456,752 for an example configuration of a fibrillated fiber.

Thus an insulating concrete (core) component may, for example, be obtained from a cementitious slurry comprising water, an hydraulically or air setting substance, short fiber (e.g. fibrillated fibers, e.g. fibrillate fibers of polypropylene) and a thermal insulating aggregate; the slurry being of predetermined thickness for allowing the slurry to be poured between wall forms which may as described herein define the face components of the wall component of a building.

Keeping the above in mind the concrete component may be a lightweight insulating

monolithic concrete core component, e.g. lightweight due to the presence of lightweight aggregate; the lightweight aggregate may also be an insulating aggregate.

In accordance with the present invention an above ground wall component for a building may be constructed by disposing a plurality of wall panels in spaced apart edge to edge relation so as to define a pair of spaced apart wall forms; any suitable means may be provided for joining the adjacent edges of the panels together. The wall forms may be braced in position in any suitable (known) fashion, e,g, the wall forms may be interconnected by any suitable attachment means e.g. by non-metallic tie holders such as a thermally resistant (i.e. heat transfer resistant) tie members which may be made of any suitable plastic material able to provide the desired or necessary heat transfer resistance. The panels may be of any desired or suitable material such as wood, polymeric materials etc. or even metal; the panels may in particular be wood chip panels or boards. If the panels are interconnected by tie members, the tie members may advantageously be made of low thermal conductivity material in order not to detract from the insulating characteristics of the concrete component of the wall, e.g. plastic ties. As desired the wall forms may be configured so as to define openings for the provision of doors, windows, etc. in the obtained wall component; alternatively as the case may be such openings may be cut out of the obtained wall component by any suitable means once the insulating concrete has set e.g. the openings may be cut out by a saw or saw like device.

Once the desired wall forms are in place, an insulating concrete slurry or paste may be poured therebetween so as to fill the space between opposed wall forms and hardened in place (i.e. in-situ) to produce a poured concrete wall (core) component. Thereafter as desired or needed one or more of the wall forms may be removed. Advantageously, however if the both wall forms are suitably interconnected by tie members they may be left in place to contribute to the strength of the wall and/or insulating characteristics of the wall (i.e. if the wall forms are of polymeric insulating material such as for example polystyrene); as may be appreciated, in this case the result is a wall composite of sandwich construction comprising at least two opposed outer member layers and at least one intermediate or interposed insulating member layer.

In accordance with the present invention an insulating (lightweight) concrete may be formed by mixing the following ingredients (e.g. over a period of about 10 minutes):

- type 10 or 30 cement (100 to 500 kg per cubic metre)
- 40 to 300 litres of water per cubic metre
- 50 ml to 500 ml per 100 kg of cement of a suitable air entraining agent (such as, for example Micro Air by Masterbuilder Technologies, Montreal Quebec, Canada)
-0.5 to 1 kg per cubic meter of polypropylene fibers having a length of 10 mm to 40 mm
- 500 to 1000 litres of polystyrene beads (e.g. of 1 mm to 5 mm in size) per

cubic meter.

An insulating concrete obtained from the above may have a compression resistance of 0.1 to 10 MPA after 28 days curing. An insulating concrete obtained from the above may have a thermal resistance of R3.0 to R0.5 per inch of thickness. The density of an insulating concrete may, for example, be 200 kg/m^3 or higher (e.g. 200 kg/m^3 to 1000 kg/m^3).

More particularly, in accordance with the present invention an insulating (lightweight) concrete may be formed by mixing the following ingredients (e.g. over a period of about 10 minutes):

- type 10 cement (200 kg per cubic metre)
- 110 litres of water per cubic metre
- 300 ml per 100 kg of cement of a suitable air entraining agent (such as for example Micro Air mentioned above)
- 1 kg per cubic meter of fibrillated polypropylene fibers having a length of 10 mm to 40 mm
- 1000 litres of polystyrene beads (of, for example, 1 mm to 5 mm size, e.g. 2.5 mm to 4 mm) per cubic meter.

An insulating concrete obtained from the above may have a compression resistance of 0.5 MPA after 28 days curing. An insulating concrete obtained from the above may have a thermal resistance of R2.15 per inch of thickness. The density of the insulating concrete may, for example, be 320 kg/m^3.

In accordance with the present invention the insulating concrete may be made in accordance with the teachings of Canadian Patent no. 1,283,666, i.e. the insulating concrete may, for example, have a density 400 kg/m^3 to 1000 kg/m^3.

In drawings which illustrate example embodiments of the present invention:

Figure 1 is a perspective view of a pair of wall forms with insulated concrete hardened therebetween wherein each wall form is defined by a plurality of wood-chip panels attached together in edge to edge fashion by retainer members, the wall forms being interconnected by transversely extending tie members;

Figure 2 is a plan view of a wood chip panel used to form the wall forms shown in figure 1;

Figure 3 is a plan view of a retainer member shown in figure 1 which is used to attach the wood chip panels together in edge to edge fashion;

Figure 4 is a schematic side view of a tie member shown in figure 1 for interconnecting the wall forms;

Figure 5 is an enlarged schematic perspective view showing a tie member

being installed in aligned notches in adjacent panels and in the notch of a retainer member;

Figure 6 is an enlarged schematic perspective view showing a tie member secured to a retainer member, the retainer member being attached to adjacent wood chip panels by attachment elements (e.g. wood screws);

Figure 7 is a schematic side view of an example combined or unitary retainer/tie member in accordance with the present invention;

Figure 8 is an end view of the unitary retainer/tie member shown in figure 7;

Figure 9 is a schematic cross-sectional view of an empty wall form structure before insulating concrete slurry is poured between the wall forms thereof to fill the space therebetween;

Figure 10 is a schematic top view of an empty example wall form structure configured to define a rectangular wall component before insulating concrete slurry is poured between the wall forms to fill the space therebetween; and

Figure 11 is a schematic illustration of a building with a peaked roof sitting on a wall component in accordance with the present invention.

Referring to figures 1 to 6, a pair of wall forms 1 and 2 are shown in a spaced apart and a more or less parallel relationship. Each of the wall forms 1 and 2 are made up of a plurality of wood chop panels 4. The panels 4 are arranged in abutting edge to edge relationship. A plurality of tie members 6 interconnect the wall forms 1 and 2; the tie members 6 may, for example, be of any suitable thermally resistant plastic material. The tie members 6 are disposed at the edge interface 5 between adjacent abutting wood chip panels 4. A plurality of retainer members 10 attaches adjacent wood chip panels together. The opposed ends of each tie member 6 engages a slot 11 of a respective retainer member 10.

Once the wood chip panels 4, tie members 6 and retainer members 10 are arranged as shown in figure 1 (and if necessary braced by bracing members 15 as shown in figure 9) insulating concrete slurry is poured into the space between the wall forms where it is allowed to cure (i.e. harden). In figure 1 the hardened insulating concrete is designated generally by the reference numeral 11; the insulating concrete 11 includes in its matrix thermal insulating aggregate, one aggregate element being designated generally by the reference numeral 12. The panels 4 may have a thickness of 15/32 of an inch whereas the insulating concrete may have a thickness between the panels 4 of 7.5 inches. In the embodiment shown the wood chip panels are left in place and

if desired additional facade (i.e. finishing) components such as gypsum board for the interior side and weather proof siding or cladding for the exterior side may be attached thereto in any suitable manner (e.g. by screws, nails, etc.).

Each wood chip panel 4 of figure 1 is provided with a plurality of edge notches 20 (see figure 2). For illustration purposes, only four notches 20 are shown per edge of the panel 4 in figure 2; a panel could of course have more or less notches 20 depending on the circumstances such as the wall height, thickness etc... These notches 20 are disposed so as to align with the corresponding notches of a similar adjacent wood chip panel. Retainer members 10 are shown by way of example only as being attached to adjacent wood-chip panels by screw elements 25 (see figure 6) which extend into the panels through respective openings 30 in the retainer members 10. Referring in particular to figure 4 the tie members 6 are provided at each extremity thereof with an annular notch 35 and include a head part 40 which is larger than the notch 11 of a retainer member 10; the tie members 6 have a neck part 45 which is sized smaller than the notch 11. The portion of the tie members 6 behind each of the neck parts 45 is sized smaller than the notchs 20 in the wood chip panels.

Referring in particular to figures 5 and 6, the neck part 45 of the tie member 6 is disposed into the notch 11 of the retainer member 10. The retainer member 10 is then moved in the direction of the arrow 47 and is attached to one wood chip panel 4 such that the notch 11 thereof is aligned with the notch 20 of the respective wood

chip panel 4 and the tie member 6 is disposed in the notch 20 of the wood panel to which the retainer member 10 is attached. Thereafter another wood chip panel 4 is disposed in edge to edge relation with the wood chip panel 4 to which the retainer member 10 is attached (e.g. by screws 25) such the notches 20 thereof are aligned with the correspond notchs 20 of the adjacent panel 4 and the tie member 6 engages a respective notch 20 thereof. The retainer member 10 is then (screw) attached to this other wood chip panel 4 as well. This process is of course carried out is in similar fashion with respect to the other retainer and tie member combinations for attaching the wood chip panels 4 together so as to obtain the desired wall forms. The wall forms are of course disposed on a suitable footing component.

Referring to figures 7 and 8, these figures illustrate a unitary retainer/tie member 50 which has a central tie element 51 and opposed end plates 52 and 53 which are provided with screw attachment holes 55. This unitary retainer/tie member is connected to the wood panels in analogous fashion to the attachment of the separate retainer and tie members 10 and 6 respectively.

Referring to figure 9 the empty wall form structure comprising the wall forms 1 and 2 may if desired or necessary be braced by bracing members 15 during the pouring and hardening process; the insulating concrete slurry or paste is poured between the forms 1 and 2 in the direction of the arrow 60. The bracing members 15 are intended to be removed once the insulating concrete is cured, i.e. hardened. The

wood chip panels 4 are on the other hand left in place as part of the wall component; the interconnected wood chip panels 4 enhancing the strength of the wall component.

Referring to Figure 10, this figure is a schematic top view of an empty example wall form structure configured to define a rectangular wall component before insulating concrete slurry is poured between the wall forms to fill the space therebetween;. After curing of the insulating concrete a roof component (not shown) may for example be disposed upon the so obtained wall component; the roof component may for example be flat, sloped etc. Figure 11 shows in schematic fashion a building with a peaked roof 70 sitting on a wall component 75 in accordance with the present invention.

I claim:

1. In a building comprising an above ground wall component comprising a monolithic concrete component, said above ground wall component having a degree of strength to function as a load-bearing building wall,
the improvement wherein the monolithic concrete component comprises an insulating concrete.

2. In a building comprising an above ground composite wall component, said above ground composite wall component comprising a pair of face components spaced apart by an intermediate monolithic concrete core component disposed therebetween, said above ground composite wall component having a degree of strength to function as a load-bearing building wall,
the improvement wherein the concrete core component comprises an insulating concrete.

3. A building as defined in claim 2 wherein said insulating concrete is a lightweight insulating concrete.

4. A building as defined in claim 2 wherein each face component comprises a

plurality of panel elements arranged edge to edge.

5. A building as defined in claim 4 wherein said panel elements are each wood chip panel elements.

6. A building as defined in claim 4 wherein said panel elements are secured together by thermal insulating connecting members.

7. A building as defined in claim 5 wherein said panel elements are secured together by thermal insulating connecting members.

8. A building as defined in claim 1 wherein the concrete component comprises thermal insulating aggregate.

9. A building as defined in claim 2 wherein the concrete component comprises thermal insulating aggregate.

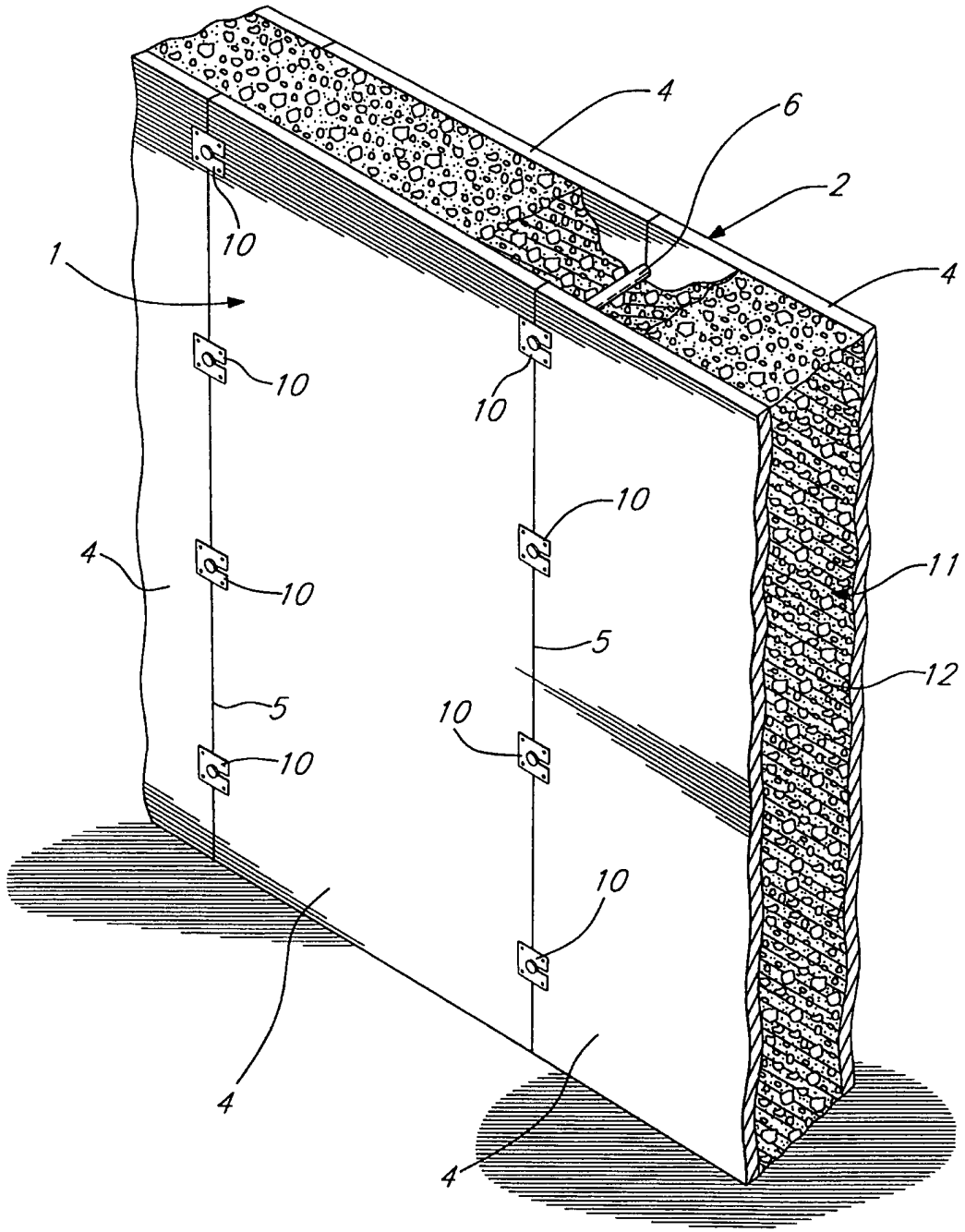

Fig. 1

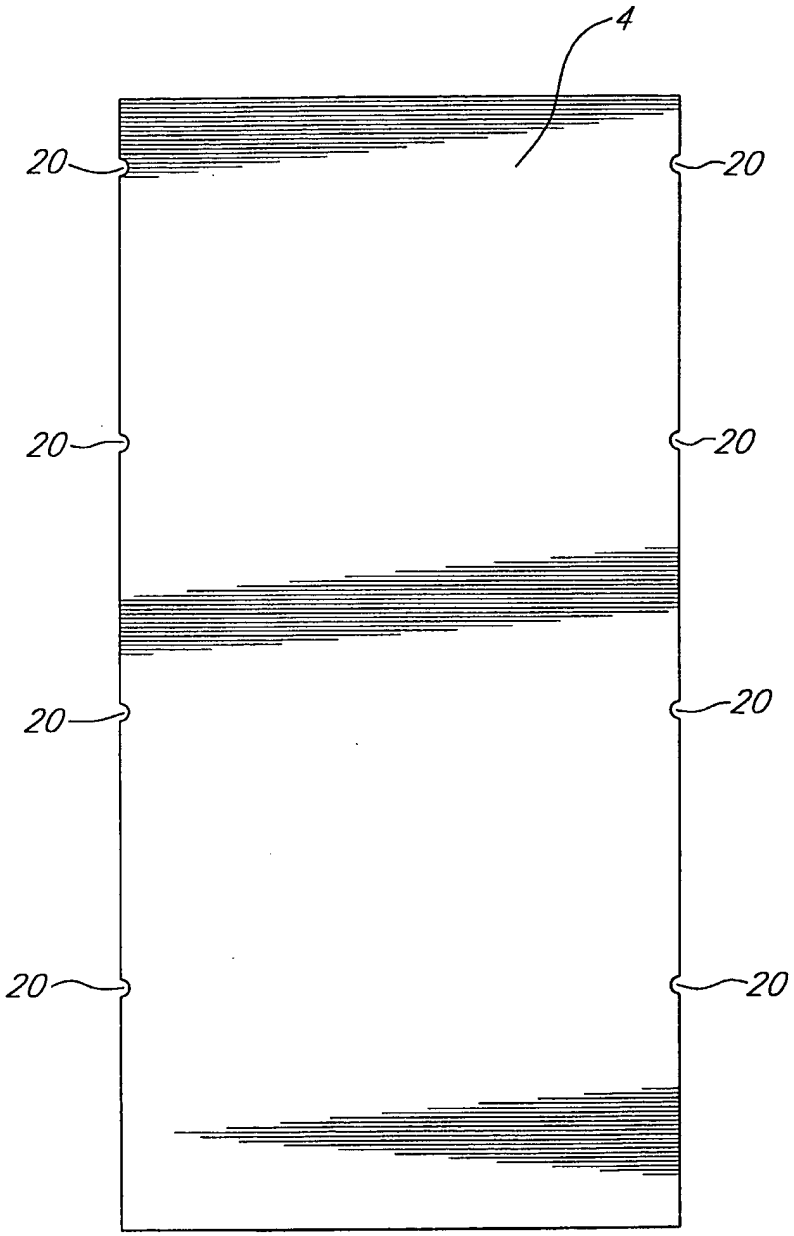

Fig. 2

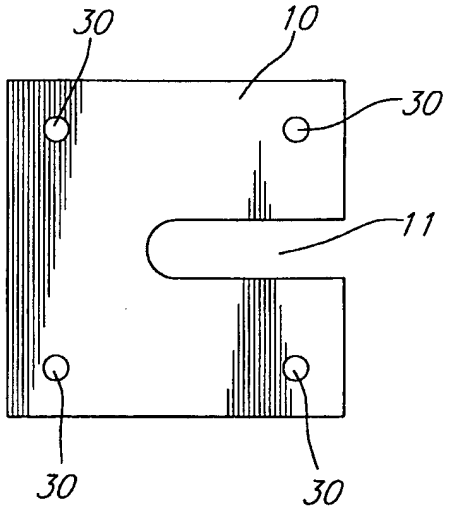

Fig. 3

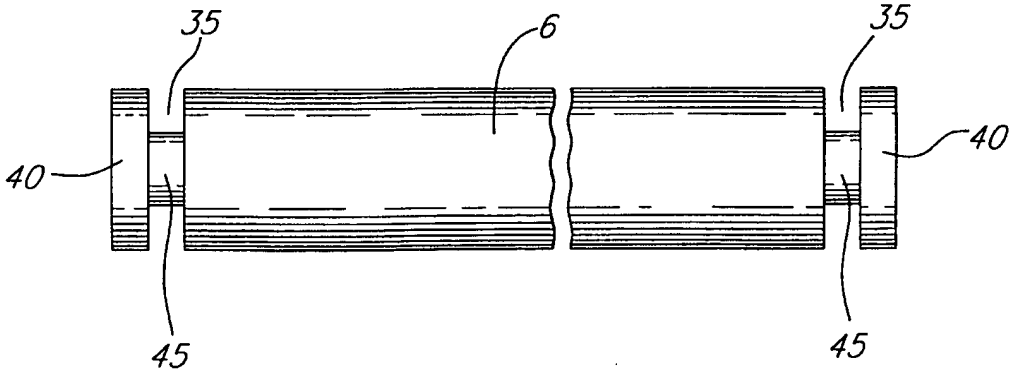

Fig. 4

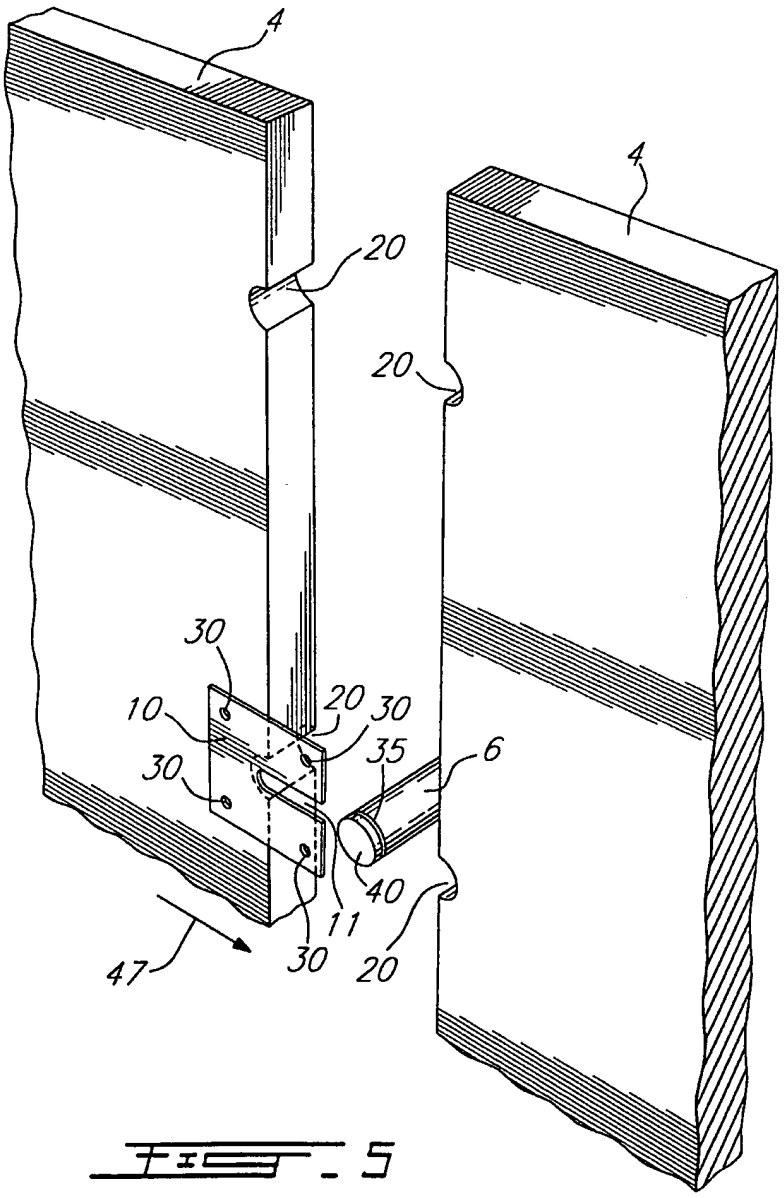

Fig - 5

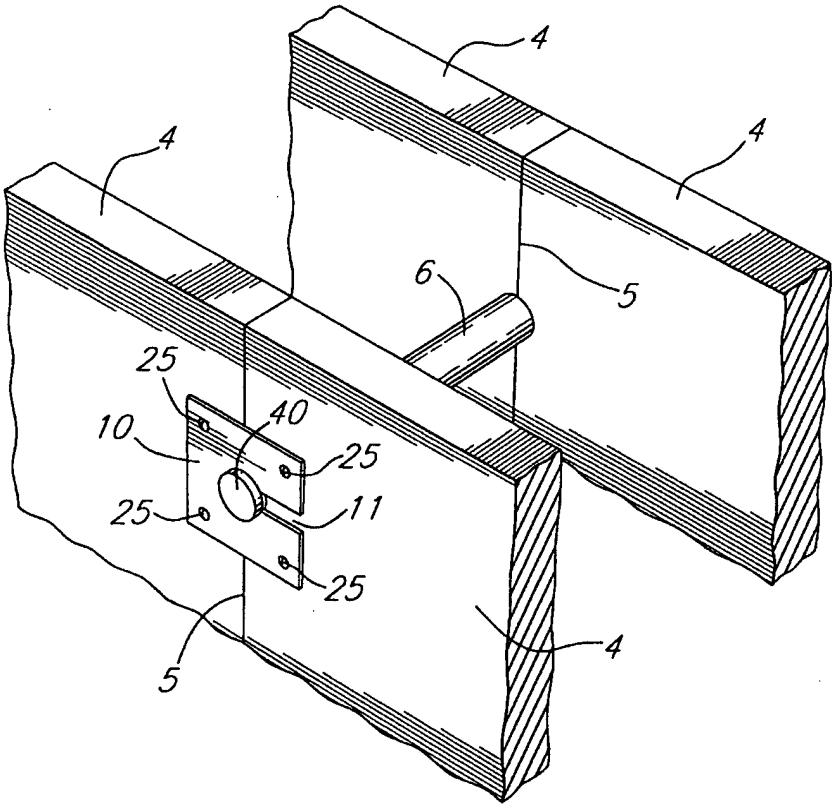

Fig. 6

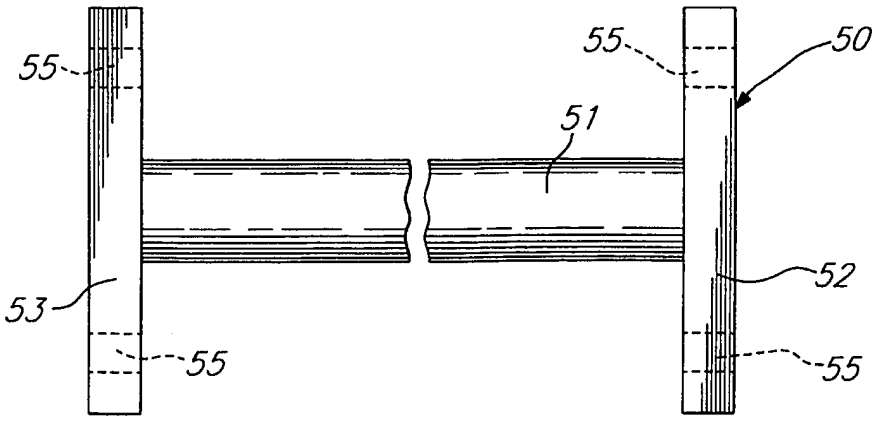

Fig. 7

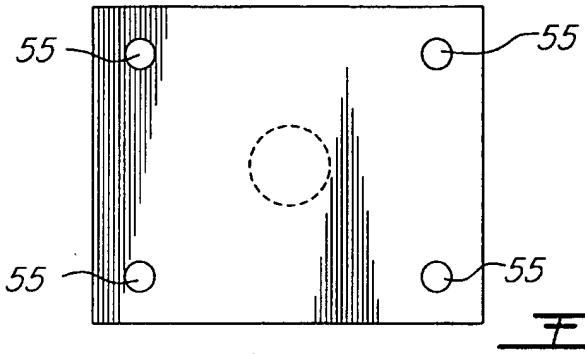

Fig. 8

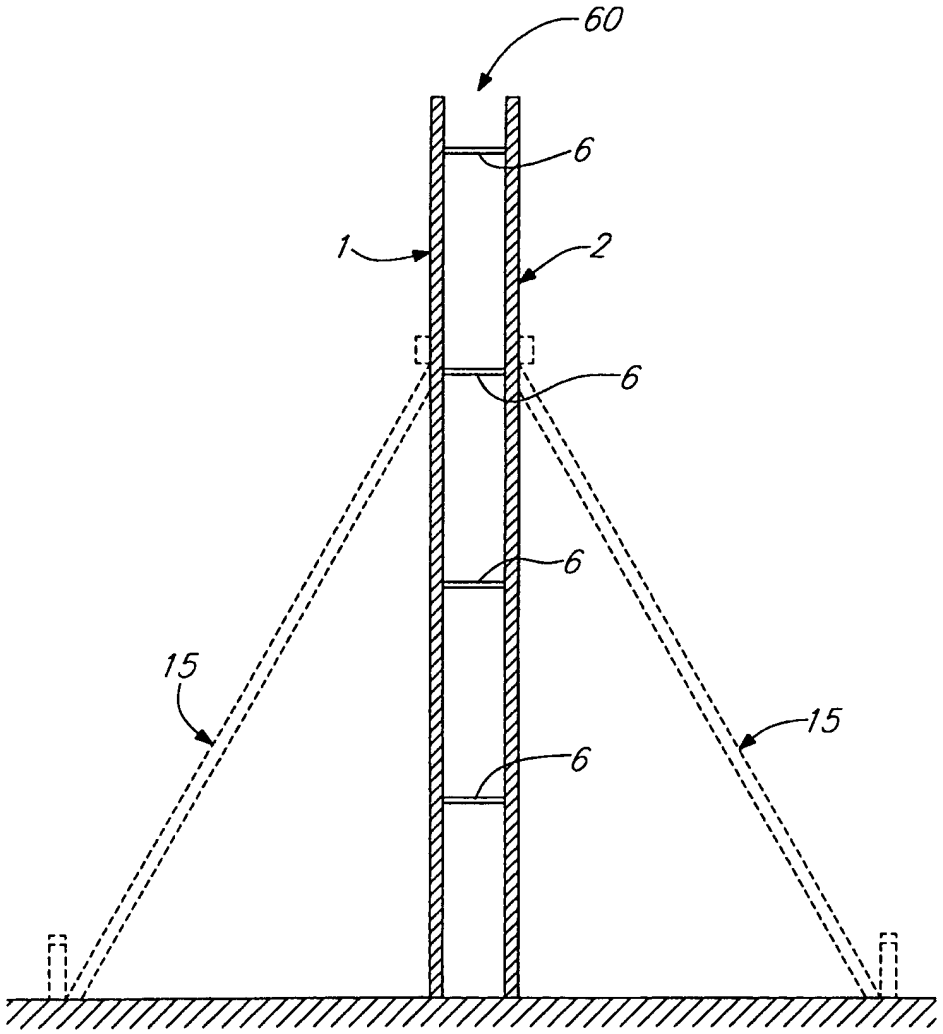

Fig. 9

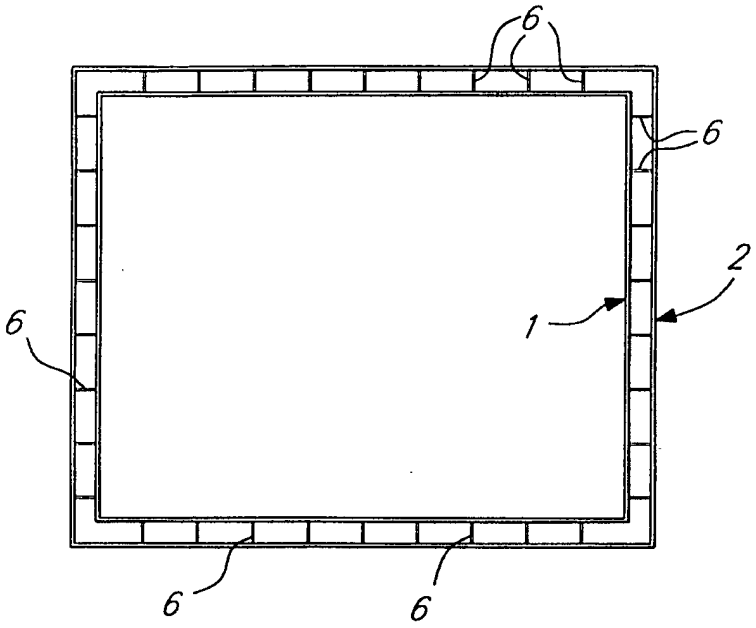

Fig - 10

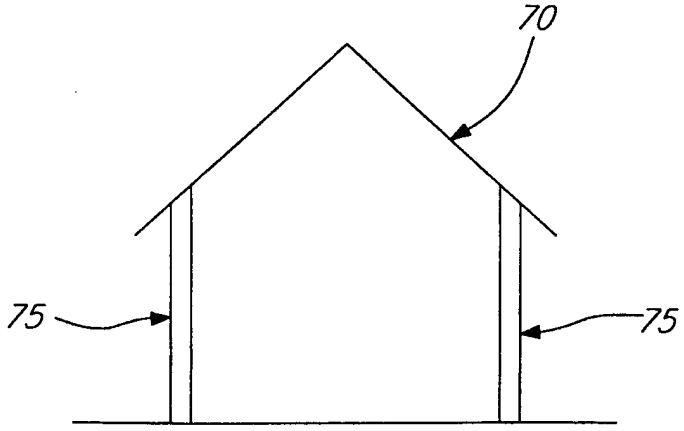

Fig - 11

INTERNATIONAL SEARCH REPORT

Interna Application No
PCT/CA 99/00154

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E04B2/86

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 626 027 A (ANTOLINOS JEAN) 21 July 1989 see page 2, line 37 - page 4, line 9; figure 1	1,8
X	WO 95 33107 A (ORRIERE GERARD) 7 December 1995 see page 7, line 39 - page 8, line 20; claim 5; figures 1,2	2-4,9
Y		5-7
Y	DE 11 03 549 B (ALPINE ISO-SPAN) 30 March 1961 see column 1, line 22 - line 23; figure 1	5
Y	FR 2 691 732 A (ORRIERE GERARD) 3 December 1993 see page 7, line 9 - line 10; figure 8	6,7

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 May 1999	07/06/1999

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Interna: Application No
PCT/CA 99/00154

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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